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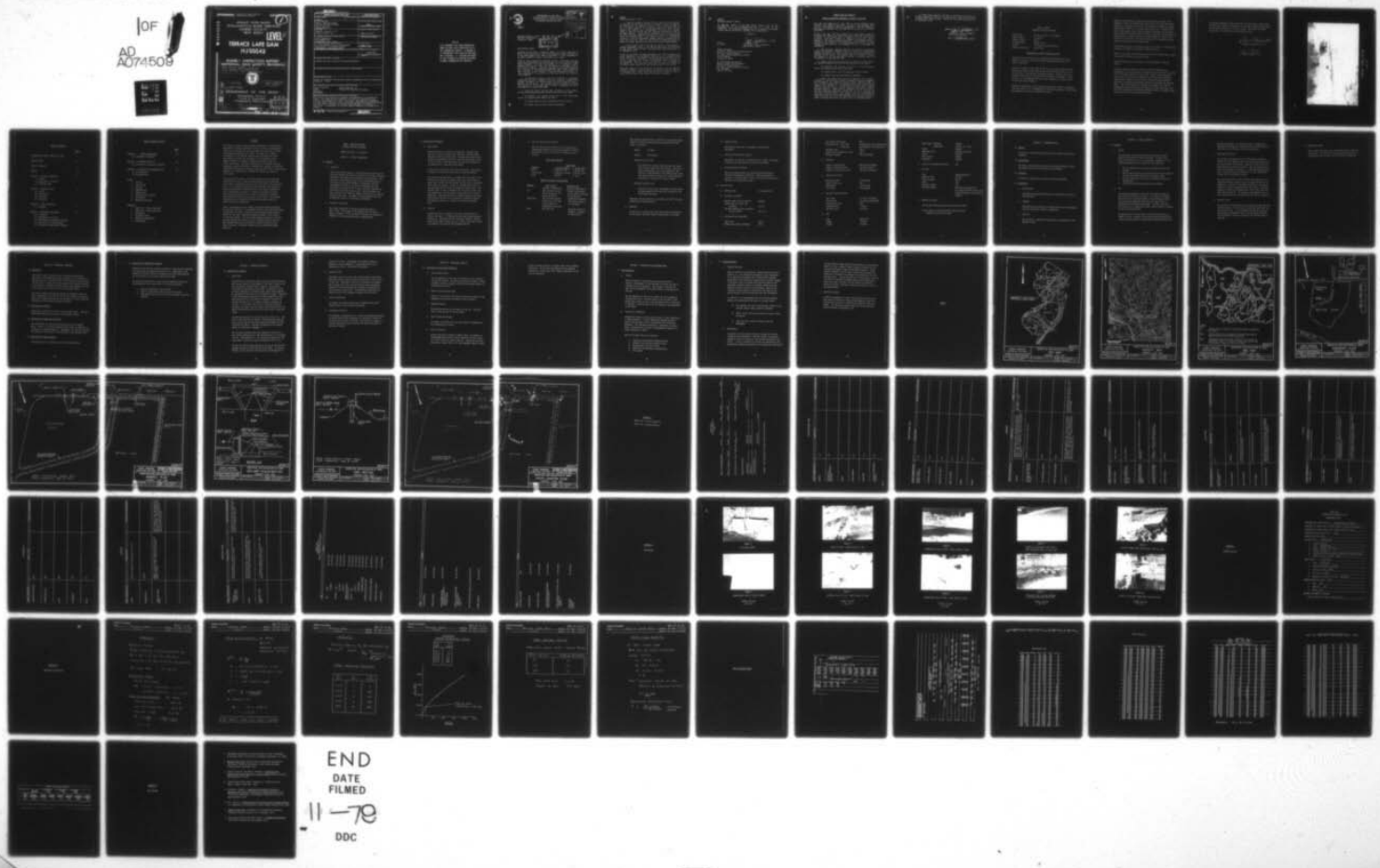

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PASSAIC RIVER BASIN
PEQUANNOCK RIVER TRIBUTARY
MORRIS COUNTY
NEW JERSEY

LEVEL II

TERRACE LAKE DAM
NJ00542

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM.

(6) Terrace Lake Dam (NJ-00542). Passaic River Basin. Pequannock River Tributary, Morris County, New Jersey. Phase 1 Inspection Report.

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(10) Richard J. /McDermott
John E. /Gribbin

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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Dams
Spillways
Embankments
Terrace Lake Dam, N.J.
National Dam Inspection Act Report

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Terrace Lake Dam in Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Terrace Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 7 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is the One Hundred Year Flood.) To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Within six months from the date of approval of this report, the following remedial measures should be undertaken by the owner:

(1) Renovate the concrete core wall in the north-south section of the dam (eastern edge of the lake).

(2) Remove debris in the stilling basin and box culvert.

(3) Remove trees and brush from the embankment.

c. Within six months from the date of approval of this report, the owner of the dam should initiate a program of periodic inspection and maintenance, the complete records of which should be kept on file. A visual inspection of the dam and appurtenances should be made annually and reported on a standardized check-list form. Repairs should be made as required and the following maintenance should be performed annually: remove adverse vegetation from the dam, inspect the gate operating mechanisms, perform any necessary servicing and clear the spillway apron. The current practice of periodically lowering the lake for maintenance purposes should be continued and at least once every five years the lake should be completely drained to permit a thorough inspection and repair of the dam and appurtenances.

d. Within twelve months of the date of approval of this report, a detailed topographic survey of the dam and area around the dam, based on USGS datum, should be made. The survey map should become part of the permanent record.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-D
Honorable Brendan T. Byrne

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
for District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

TERRACE LAKE DAM (NJ00542)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 2 May 1979 by Storch Engineers under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Terrace Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 7 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is the One Hundred Year Flood.) To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

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d. Within twelve months of the date of approval of this report, a detailed topographic survey of the dam and area around the dam, based on USGS datum, should be made. The survey map should become part of the permanent record.

APPROVED: Jack Callahan LTC
for JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 12 September 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Terrace Lake Dam, I.D. NJ00542
State Located:	New Jersey
County Located:	Morris
Drainage Basin:	Passaic River
Stream:	Tributary to Pequannock River
Date of Inspection:	May 2, 1979

Assessment of General Condition of Dam

Based on visual inspection, past operational performance and Phase I engineering analyses, Terrace Lake Dam is assessed as being in fair overall condition.

Because its height is less than 25 feet and its storage capacity is less than 50 acre-feet, Terrace Lake Dam does not meet the minimum criteria for inclusion in the National Dam Safety Program. However, since preliminary investigations indicate that the subject dam presents a hazard to life, it is recommended that this Phase I Report be included in the National Dam Safety Program.

Based on investigations of the downstream flood plain made in connection with this report, it is recommended that the hazard potential classification be downgraded from high to significant hazard.

Hydraulic and hydrologic analyses indicate that the spillway is not adequate to pass the designated spillway design flood (100-year storm) without an overtopping of the dam. The spillway is capable of passing approximately 6 percent of the spillway design flood. Therefore, the owner should engage a professional engineer experienced in the design and construction of dams in the near future to perform accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of the analyses, the need for and type of mitigating measures should be determined and then implemented.

The exposed core wall at the eastern edge of the lake is in deteriorated condition and should be renovated in the near future.

Debris on the apron of the spillway and in the box culvert under Terrace Road should be removed in the near future.

Trees and brush should be removed from the embankment in the near future.

The owner should initiate a program of periodic inspection and maintenance in the near future, the complete records of which to be kept on file and made available to the public. Repairs should be made as required and the following maintenance should be performed annually: remove adverse vegetation from the dam, inspect the gate operating mechanisms and perform any necessary servicing, and clear the spillway apron. The current practice of periodically lowering the lake for maintenance purposes should be continued and at least once every five years the lake should be completely drained to permit a thorough inspection and repair of the dam and appurtenances.

A detailed topographic survey of the dam and area around the dam, based on USGS datum, should be performed by a qualified licensed land surveyor or professional engineer in the near future. The survey map should become part of the permanent record mentioned above.

Richard J. McDermott

Richard J. McDermott, P.E.

John E. Gribbin

John E. Gribbin, P.E.

OVERVIEW - TERRACE LAKE DAM

2 MAY 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 30214. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TERRACE LAKE DAM, I.D. NJ00542

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers to initiate a National Program of Dam Inspection throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Terrace Lake Dam was made on May 2, 1979. The purpose of the inspection was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description

Terrace Lake Dam is an earth fill dam with a concrete core wall and a concrete overflow weir spillway. The dam extends east-west as well as north-south. The east-west section has a length of approximately 487 feet while the north-south section is 250 feet long. Both sections of the dam are straight and are adjoined at a right-angle bend point.

A gravel dike divides the lake into two sections. One section is used as a swim area and the other is used for boating.

The concrete spillway, which is located near the center of the east-west dam section, discharges into a box culvert under a paved road. Neither the box culvert nor the road is considered to be a part of the dam. A fence is located on the crest of the east-west section of the dam along its entire length. The spillway crest is set at elevation 511.9 (N.G.V.D.) while the pool elevation is normally lower and was 510.8 at the time of inspection. The pool elevation is normally below the spillway crest because the lake is not located on a perennial stream. The height of the dam is 7.0 feet at the outlet discharge pipe.

b. Location

Terrace Lake Dam is located in the Town of Butler, Morris County, New Jersey. It impounds Terrace Lake located adjacent to Route 23. Discharge from the lake flows through a culvert under Terrace Road, then by way of a natural stream bed through a residential area and into the Pequannock River.

c. Size and Hazard Classification

Size and Hazard Classification criteria presented in "Recommended Guidelines for Safety Inspection of Dams", published by the U.S. Army Corps of Engineers are as follows:

SIZE CLASSIFICATION

	Impoundment	
Category	Storage (Ac-ft)	Height (Ft)
Small	< 1000 and ≥ 50	< 40 and ≥ 25
Intermediate	≥ 1000 and $< 50{,}000$	≥ 40 and < 100
Large	$\geq 50{,}000$	≥ 100

HAZARD POTENTIAL CLASSIFICATION

Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	None expected (no permanent structures for human habitation)	Minimal (Undeveloped to occasional structures or agriculture)
Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than few	Excessive (Extensive community, industry or agriculture)

The following characteristics relating to size and downstream hazard for Terrace Lake Dam have been determined for this Phase I assessment:

Height: 7.0 feet

Storage: 27 acre-feet

Potential Loss of Life:

One dwelling is located directly across the paved road (Terrace Road) from the spillway. Dam failure due to overtopping would cause inudation of the dwelling of approximately 1 foot above ground level. Two other dwellings located near a small downstream pond would be inundated to a lesser extent.

Potential Economic Loss:

Dam failure could cause some damage to Terrace Road and approximately three dwellings located near the small downstream pond.

Therefore, Terrace Lake Dam is classified as "Small" size and "Significant" hazard potential.

d. Ownership

Terrace Lake is owned by Christian Recreational Association, c/o Van Grouw, 164 Erwin Street, Midland Park, N.J. 07432

e. Purpose of Dam

The purpose of the dam is to impound a lake used for recreation.

f. Design and Construction History

Reportedly, the dam was constructed prior to 1952. No records of design and construction of the dam are available.

g. Normal Operation Procedure

The dam and appurtenances are operated and maintained by Christian Recreational Association. Regular maintenance consists of cleaning debris from the swim area and lowering of the lake for cleaning once a year.

1.3 Pertinent Data

a.	Drainage Area	0.5 square miles
b.	Discharge at Damsite	
	Maximum known flood at damsite	Unknown
	Outlet works at normal pool elevation	8 c.f.s.
	Spillway capacity (pool elevation at top of dam)	42 c.f.s.
c.	Elevation (Feet above MSL).	
	Top of dam	512.8
	Maximum pool-design surcharge	513.3

Full flood control pool	N.A.
Recreation pool - main lake	510.8±(varies with precipitation
- swim area	512.3(summer); 510.8±(winter)
Spillway crest	511.9
Stream bed at centerline of dam	505.8
Maximum tailwater	510± (Estimated)

d. Reservoir

Length of maximum pool	800 feet (Estimated)
Length of recreation pool	600 feet (scaled)
Length of flood control pool	650 feet (Estimated)

e. Storage (Acre-feet)

Recreation pool	11 acre-feet
Flood Control pool	N.A.
Maximum pool	32 acre-feet
Top of dam	27 acre-feet

f. Reservoir Surface (Acres)

Top of dam	9.7 acres (Estimted)
Maximum pool	10.3 acres (Estimated)
Flood control pool	N.A.
Recreation pool	7 acres
Spillway crest	8.5 acres

g. Dam

Type	Earth fill
Length	737 feet
Height	7.0 feet

Side slopes - Upstream	Unknown
- Downstream	3 horiz. to 1 vert.
Zoning	Unknown
Impervious core	Concrete core wall
Cutoff	Unknown
Grout curtain	Unknown
Foundation	Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Uncontrolled weir
Length of weir	18 feet
Crest elevation	511.9
Gates	N.A.
Approach channel	N.A.
Discharge channel	Spillway discharges into box culvert and then into a pond before discharge into downstream channel

j. Regulating outlets

12-inch pipe controlled by gate (to drain main lake)

8-inch (approx.) pipe controlled by gate (to drain swimming area into main lake)

SECTION 2: ENGINEERING DATA

2.1 Design

No plans nor calculations pertaining to the original dam could be obtained.

2.2 Construction

No records are available pertaining to the construction of either the original dam or the alteration of the spillway.

2.3 Operation

No records of operation of the lake or dam are available.

2.4 Evaluation

a. Availability

Engineering information pertaining to the design of the dam is not available.

b. Adequacy

Engineering data pertaining to Terrace Lake Dam is not adequate to be of assistance to Phase I evaluation.

c. Validity

The validity of engineering data cannot be assessed due to the absence of data.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspection of Terrace Lake Dam was performed on May 2, 1979 by staff members of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1. The dam, appurtenant structures and adjacent areas were examined.
2. The dam and accessible appurtenant structures were measured and key elevations determined by surveyor's level.
3. The dam, appurtenant structures and adjacent areas were photographed.
4. The downstream pond and culverts were surveyed.

b. Dam

The east-west embankment at the main lake area was generally grass covered with some bare areas. The corewall is exposed for most of its length and appears to be structurally intact. The north-south embankment along the east side of lake is significantly deteriorated and eroded. The dam at the swim area consists of a concrete core wall, part of which is modified to form a sliding platform.

The generalized soil description of the dam site consists of recent alluvium, composed of stratified materials deposited by streams, overlying glacial ground moraine deposited during the

Wisconsin glaciation. The glacial moraine is composed of unassorted, heterogeneous intermixed soil fractions ranging in size from clay to boulders, with silt predominant.

c. Appurtenant Structures

The spillway was observed to be in satisfactory condition. Overflow from the spillway flows onto an apron and then into a box culvert under Terrace Road. Entrance to the culvert was partly blocked by stones and debris. Near the mid-section of the road the culvert transitions to a 48-inch corrugated metal pipe. The 48-inch pipe discharges into a small pond before flowing into the downstream channel.

The outlet pipe used to drain the main lake appeared to be in adequate condition although it was not opened at the time of inspection. The gate is operated by inserting a turning key through a vertical corrugated metal pipe sleeve. The outlet pipe used to drain the swimming area into the main lake area could not be observed. Its operating stem appeared to be in fair condition but was not operated at the time of inspection.

d. Reservoir Area

The reservoir is divided into a swim area and a main lake area used for boating. The swim area is about one-fourth the size of the entire lake. It is separated from the main area by a gravel dike which appeared to be in satisfactory condition. Two recreational slides are located at the northern edge of the lake.

e. Downstream Channel

The spillway discharges into a downstream channel with very steep sides. This channel flows through the rear yards of residential houses but was dry at the time of inspection.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Terrace Lake is regulated naturally by variations in precipitation and by discharge over the spillway of Terrace Lake Dam. The outlet works of the dam can be used to drain the lake but is usually not used to augment the discharge capacity of the spillway. However, two years ago, it was opened at the time of an intense rain at the request of the Borough council.

The lake is usually lowered each spring for cleaning of the swim area. Reportedly, both sides of the lake are lowered at about the same time so that the gravel dike in the lake will not be subjected to excessive differential hydrostatic pressure.

4.2 Maintenance of the Dam

Reportedly, maintenance is done on an "as needed" basis. The most recent maintenance was patching of the concrete corewall.

4.3 Maintenance of Operating Facilities

The outlet works for the dam are maintained on an "as needed" basis. Since it is used for drawdown every spring, as reported, it is kept in an operable condition. Reportedly, the spillway structure was altered by the addition of new concrete in the Spring of 1978.

4.4 Description of Warning System

No warning system is currently in use for the subject dam.

4.5 Evaluation of Operational Adequacy

Operation of the dam has not been successful in that the dam reportedly is occasionally overtopped due to heavy rain. Reportedly, flood conditions resulting from the overtoppings have been aggravated by the low capacity of the culvert under Terrace Road.

Maintenance documentation is poor and the maintenance program for the dam appears to be insufficient in the following areas:

1. Erosion on embankment not corrected.
2. Trees on north-south section of dam not removed.
3. Deteriorated core wall in north-south section of dam not repaired.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design data

The quantity of storm water runoff that the spillway should be able to pass without an overtopping of the dam is based on the size and hazard classification of the dam. This runoff, called the spillway design flood (SDF) is described in terms of return frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Guidelines for Safety Inspection of Dam" published by the U.S. Army Corps of Engineers, the SDF for Terrace Lake Dam falls in a range of 100-year frequency to 1/2 PMF. In this case, the low end of the range, 100-year frequency, is chosen since the factors used to select size and hazard classification are on the low side of their respective ranges.

The SDF peak computed for Terrace Lake Dam is 734 c.f.s. This value is derived from the 100-year flood hydrograph computed by the use of the HEC-1-DB Flood Hydrograph Computer Program using the SCS Method. Hydrologic computations and computer output are contained in Appendix 4.

The spillway discharge rates were computed by the use of a weir formula appropriate for the configuration of its overflow section. (See Appendix 4.) The spillway discharge with lake level equal to the top of dam was computed to be 42 c.f.s.

The SDF was routed through the dam by the use of the HEC-1-DB computer program using the modified Puls method. In routing the SDF, it was found that the dam would be overtopped to a

height of 0.5 foot. Accordingly, the subject spillway is assessed as being inadequate in accordance with criteria developed by the U.S. Army Corps of Engineers.

b. Experience Data

Reportedly, the box culvert under Terrace Road is undersized and often backs up causing flooding conditions in the vicinity of the road. Reportedly, the dam is occasionally overtopped due to heavy rain and on one occasion the house immediately downstream from the spillway was inundated to approximately one foot above ground level. The inundation apparently was primarily due to the inadequate capacity of the culvert.

c. Visual Observations

No evidence was found at the time of inspection that would indicate that the dam had been overtopped.

d. Overtopping Potential

As indicated in paragraph 5.1.a. a storm of magnitude equivalent to the SDF would cause overtopping of the dam by a height of 0.5 feet above the top of the dam. The spillway is capable of passing approximately 6% of the SDF with lake level equal to the top of the dam.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The dam appeared, at the time of inspection, to be outwardly structurally stable. The north-south section, however, showed irregular vertical alignment and significant deterioration of the concrete core wall.

b. Design and Construction Data

Analysis of structural stability and construction data for the embankment and spillway structure are not available.

c. Operating Records

No operating records are available for the dam. The water level of Terrace Lake is not monitored.

d. Post Construction Changes

No changes in the dam or in the area around it subsequent to its construction are known.

e. Seismic Stability

Terrace Lake Dam is located in Seismic Zone 1 as defined in "Recommended Guidelines for Safety Inspection of Dams" which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under

seismic loading conditions if stable under static loading conditions. Terrace Lake Dam appeared to be outwardly structurally stable under static loading conditions at the time of inspection.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and Appendix 4, the spillway of Terrace Lake Dam is assessed as being inadequate. The spillway is not able to pass the SDF designated for the dam without an overtopping of the dam.

The dam appeared, at the time of inspection, to be generally structurally stable. Distress noted in the core wall of the north-south section of dam is not considered to be an indication of imminent instability due to the low height of the embankment in that area.

b. Adequacy of Information

Information sources for this study include: 1) field inspection, 2) USGS quadrangle, 3) aerial photograph supplied by Morris County Planning Board, and 4) consultation with maintenance personnel. The information obtained is sufficient to allow a Phase I assessment as outlined in "Recommended Guidelines for Safety Inspection of Dams."

Some of the absent data are as follows:

1. Stream and lake elevation gaging records.
2. Hydraulic and structural design reports.
3. Construction plans for the dam.
4. Operation and maintenance documentation.
5. Soil report.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses outlined in paragraph 5.1.a., the spillway is assessed as being inadequate. It is therefore recommended that a professional engineer experienced in the design and construction of dams be engaged in the near future to perform more accurate hydraulic and hydrologic analyses relating to spillway capacity and the effect of the box culvert on the discharge. Based on the findings of these analyses, the need for and type of mitigating measures should be determined and them implemented.

In addition, it is recommended that the following remedial measures be undertaken by the owner in the near future:

1) The concrete core wall in north-south section of dam (eastern edge of lake) should be renovated.

2) Debris in the stilling basin and box culvert should be removed.

3) Trees and brush should be removed from the embankment.

b. Maintenance

The owner of the dam should initiate a program of periodic inspection and maintenance in the near future, the complete records of which to be kept on file and made available to the public. A visual inspection of the dam and appurtenances by a professional engineer experienced in the design and construction

of dams should be made annually and reported on a standardized check-list form. Repairs should be made as required and the following maintenance should be performed annually: remove adverse vegetation from the dam, inspect the gate operating mechanisms and perform any necessary servicing, and clear the spillway apron. The current practice of periodically lowering the lake for maintenance purposes should be continued and at least once every five years the lake should be completely drained to permit a thorough inspection and repair of the dam and appurtenances.

c. Additional Studies

A detailed topographic survey of the dam and area around the dam, based on USGS datum, should be performed by a qualified licensed land surveyor or professional engineer in the near future. The survey map should become part of the permanent record mentioned in paragraph 7.2.b.

PLATES

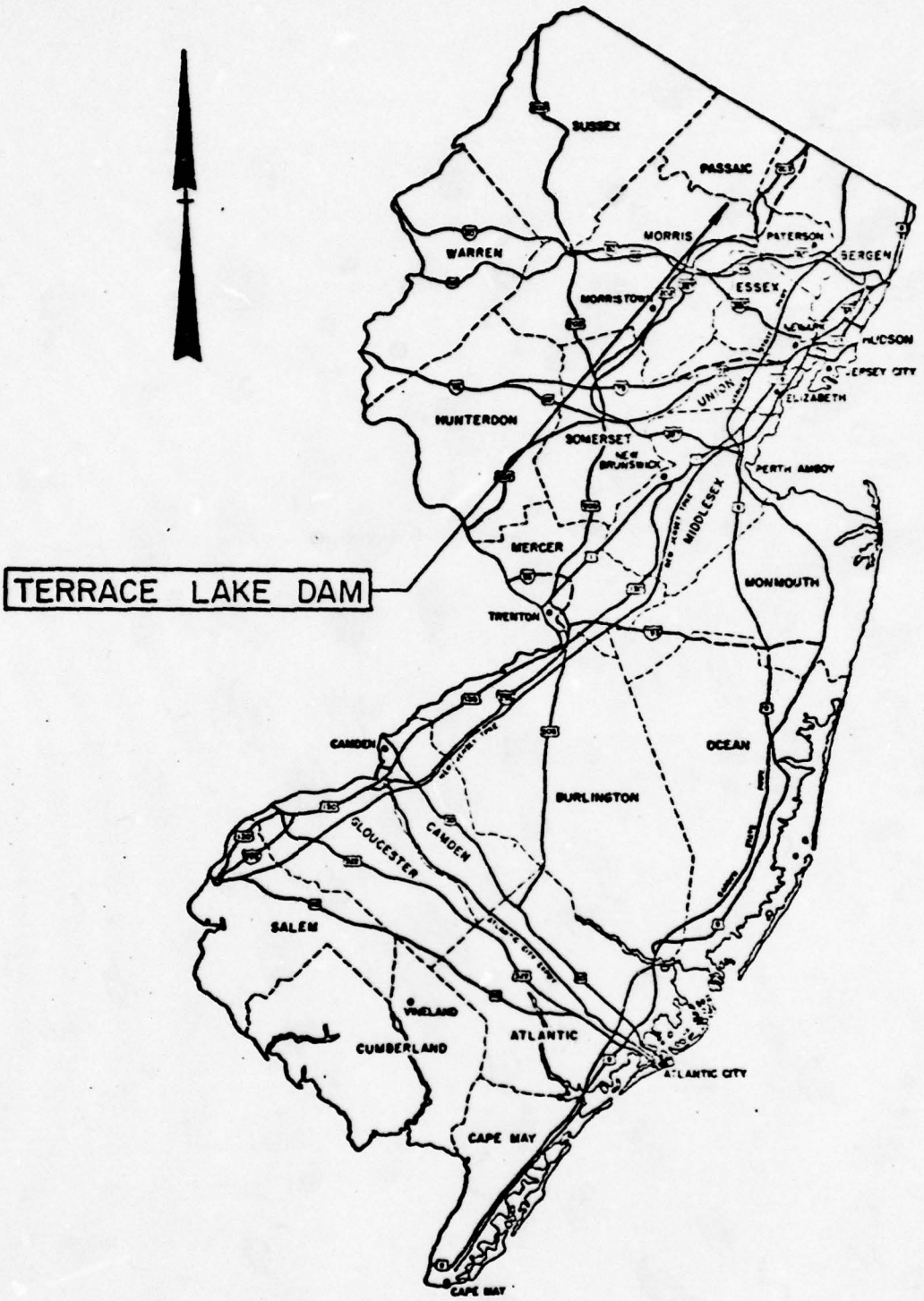


PLATE 1

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

KEY MAP

TERRACE LAKE DAM

I.D. NJ 00542	SCALE: NOT TO SCALE
	DATE: JUNE, 1979

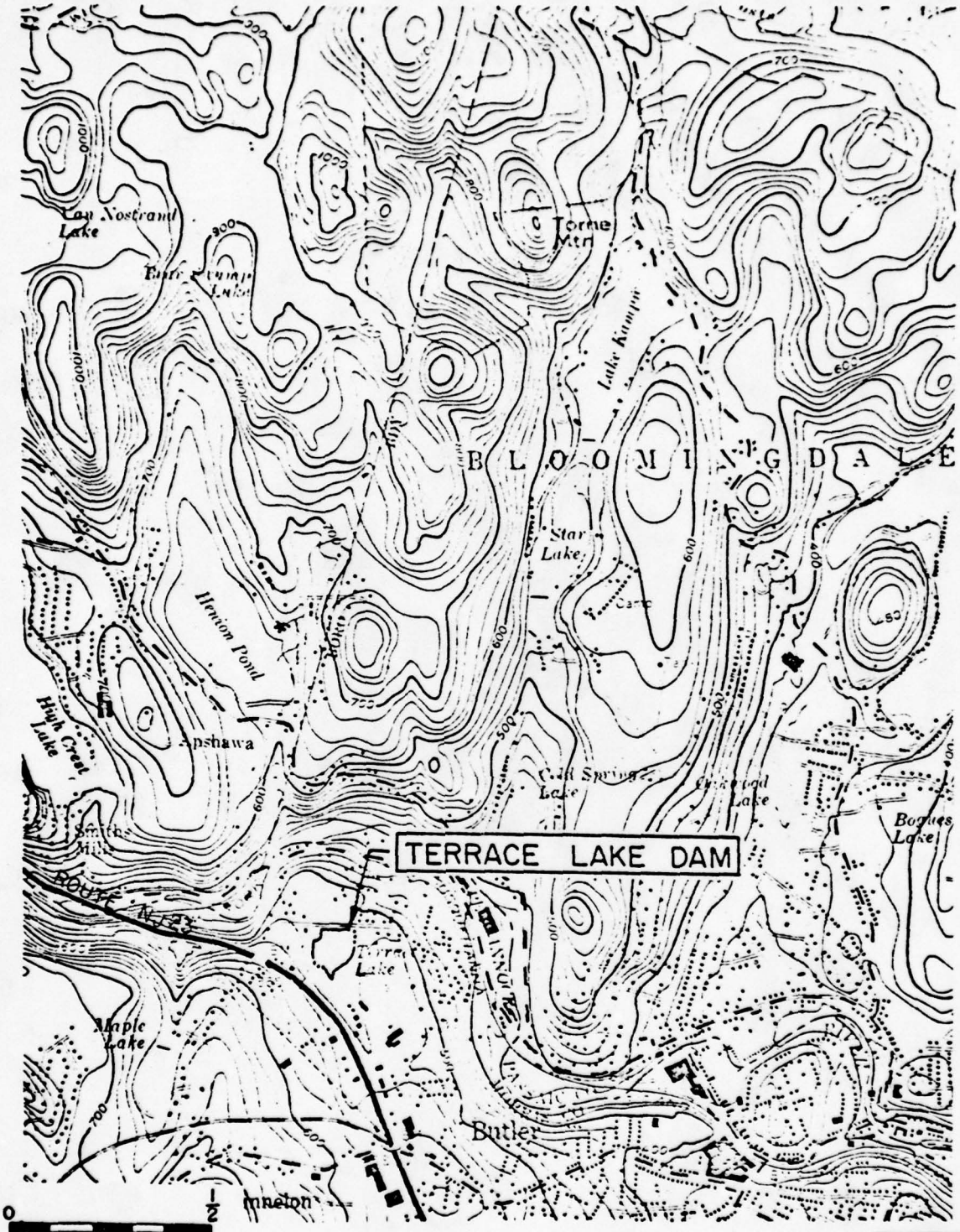
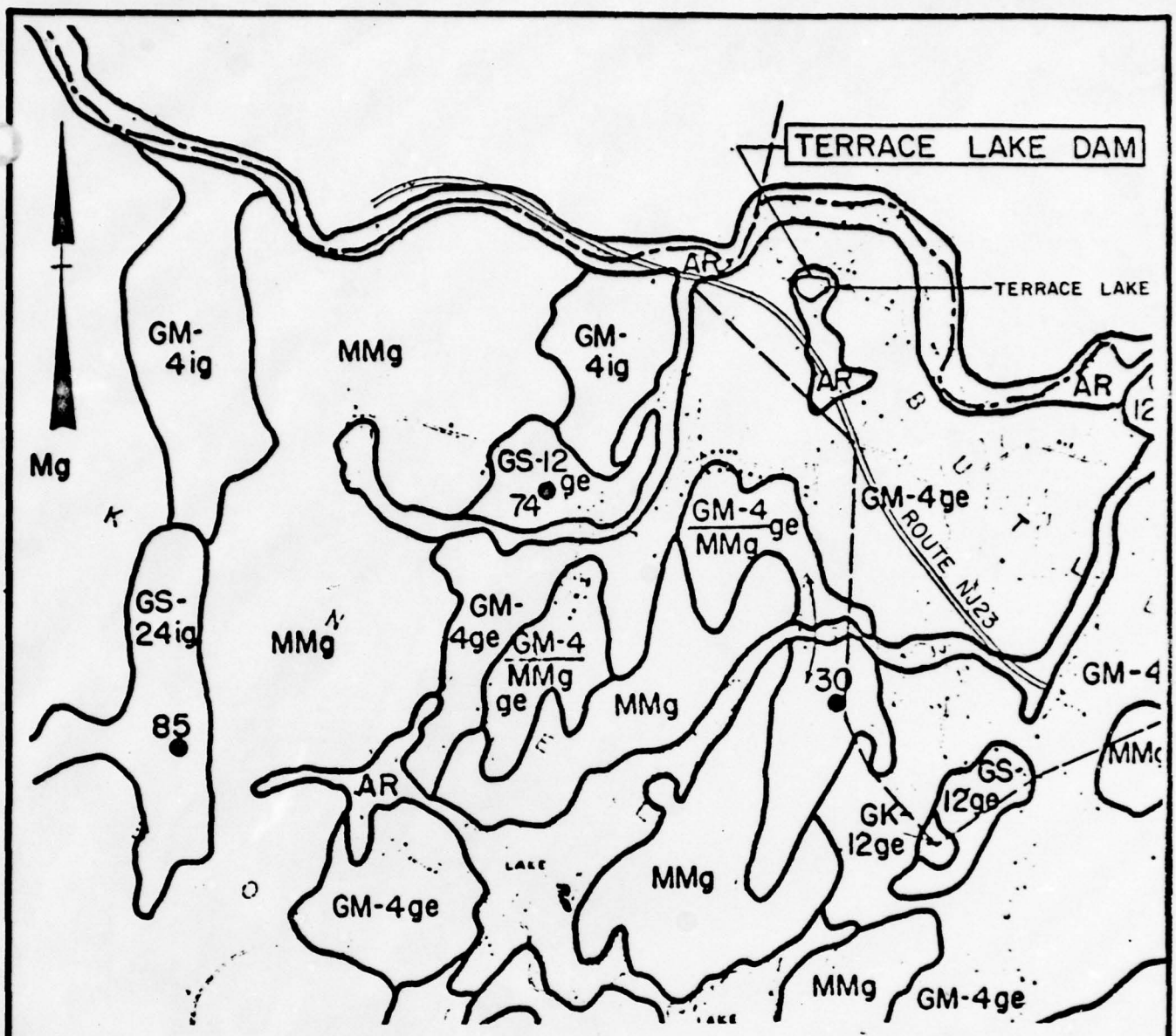


PLATE 2

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS VICINITY MAP TERRACE LAKE DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. NJ 00542 — SCALE: AS SHOWN DATE: JUNE, 1979



Legend

AR	Recent alluvium composed of stratified materials deposited by streams.
GM-4	Glacial ground moraine composed of unstratified material deposited during the Wisconsin glaciation.
NOTE:	Information taken from Rutgers University Soil Survey of New Jersey, Report No. 9, Morris County, and Geologic Map of New Jersey prepared by Lewis and Kummel.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

SOIL MAP

TERRACE LAKE DAM

I.D. NJ 00542

SCALE: NONE

DATE: JULY, 1979

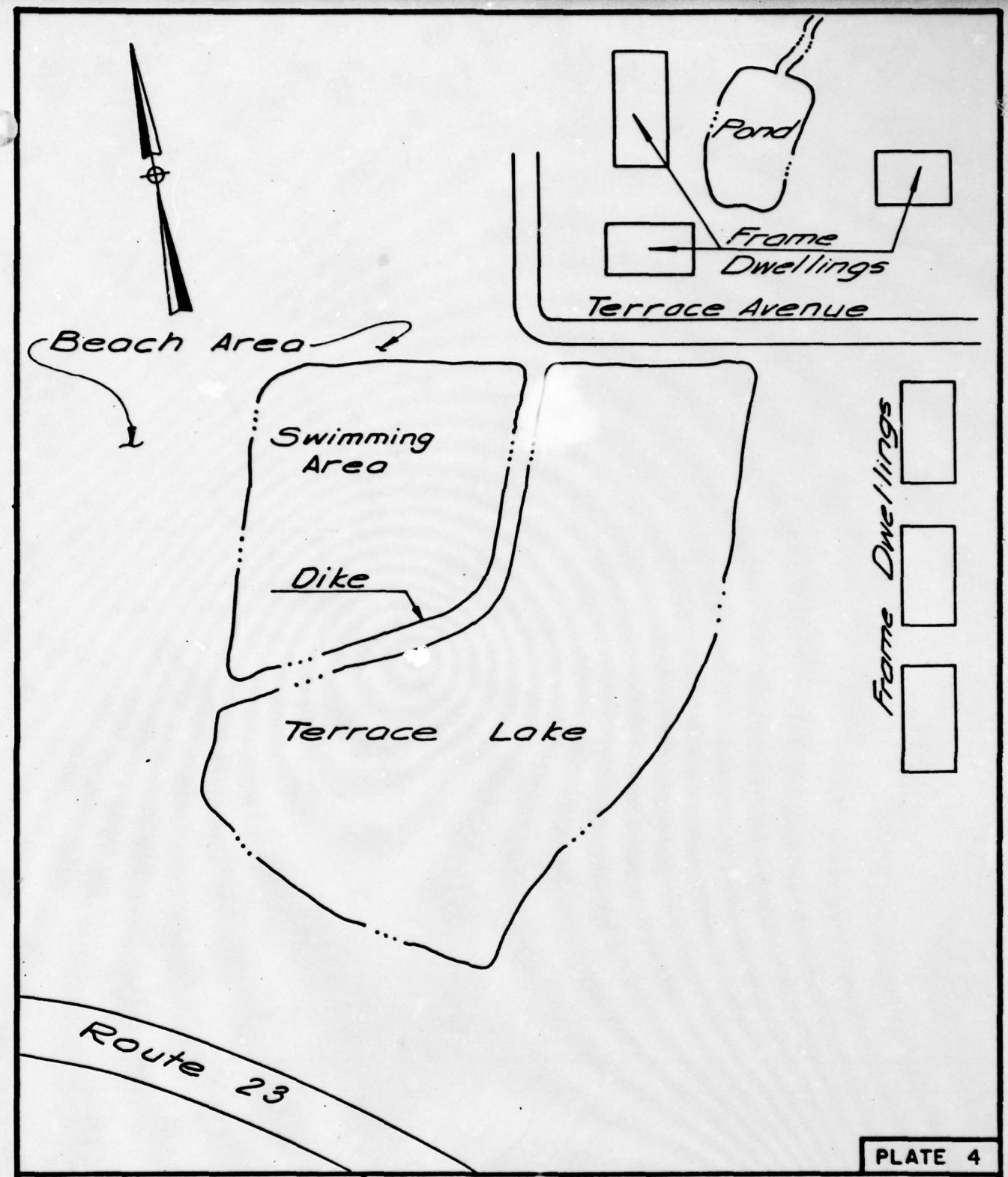


PLATE 4

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

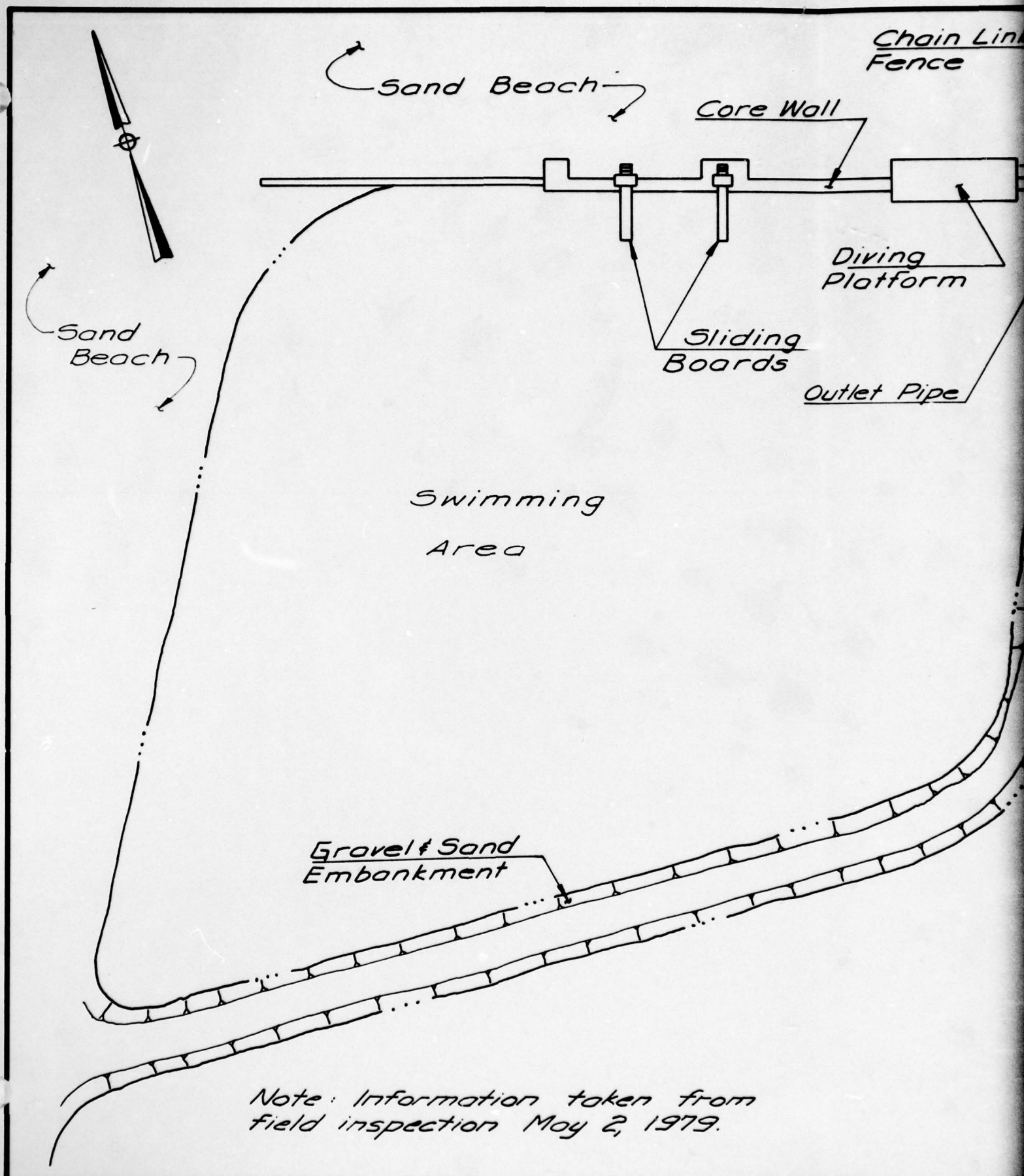
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

OVERVIEW PLAN

TERRACE LAKE DAM

I.D. NJ00542	SCALE: NOT TO SCALE
	DATE: JULY, 1979



Note: Information taken from field inspection May 2, 1979.

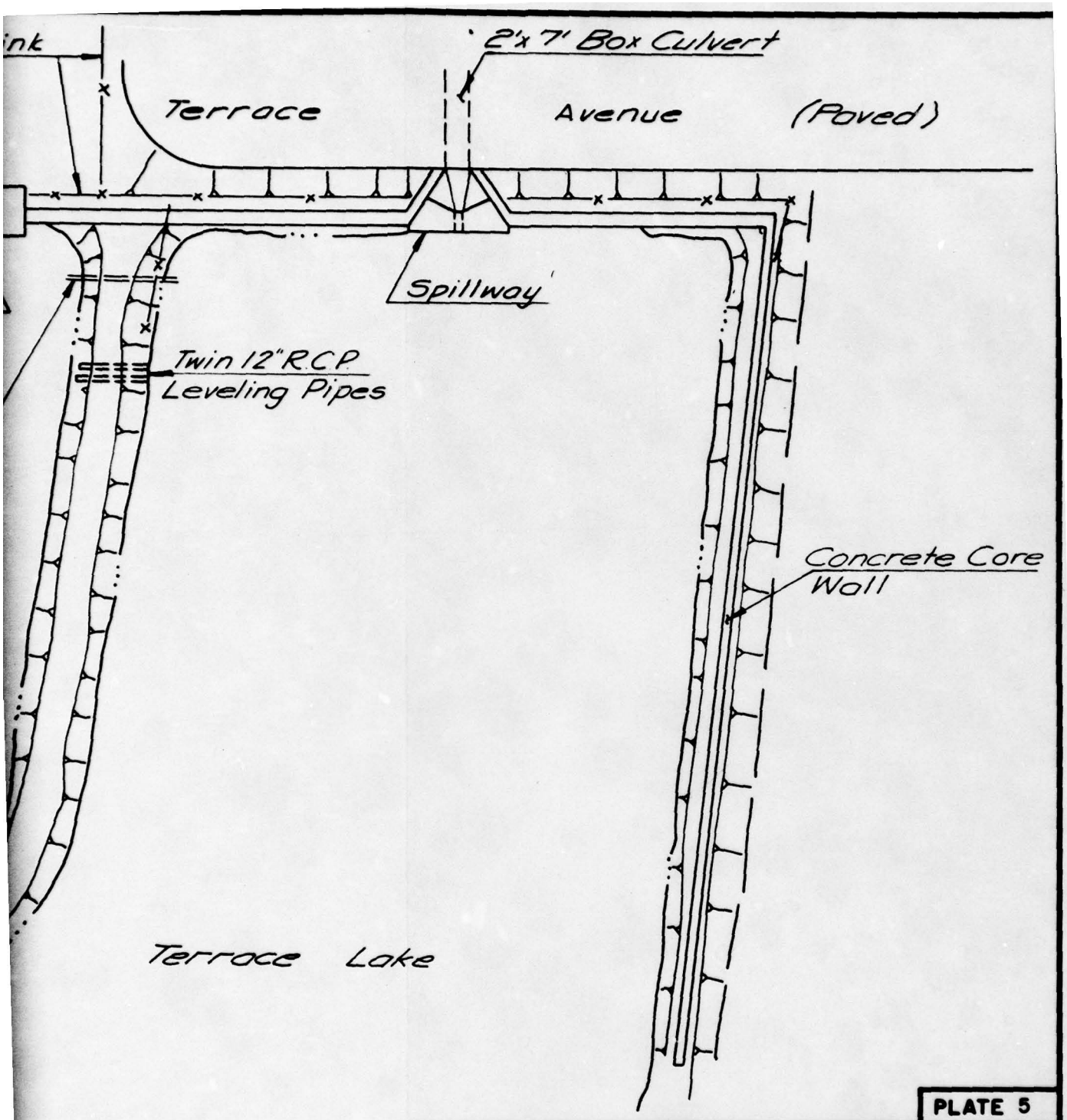


PLATE 5

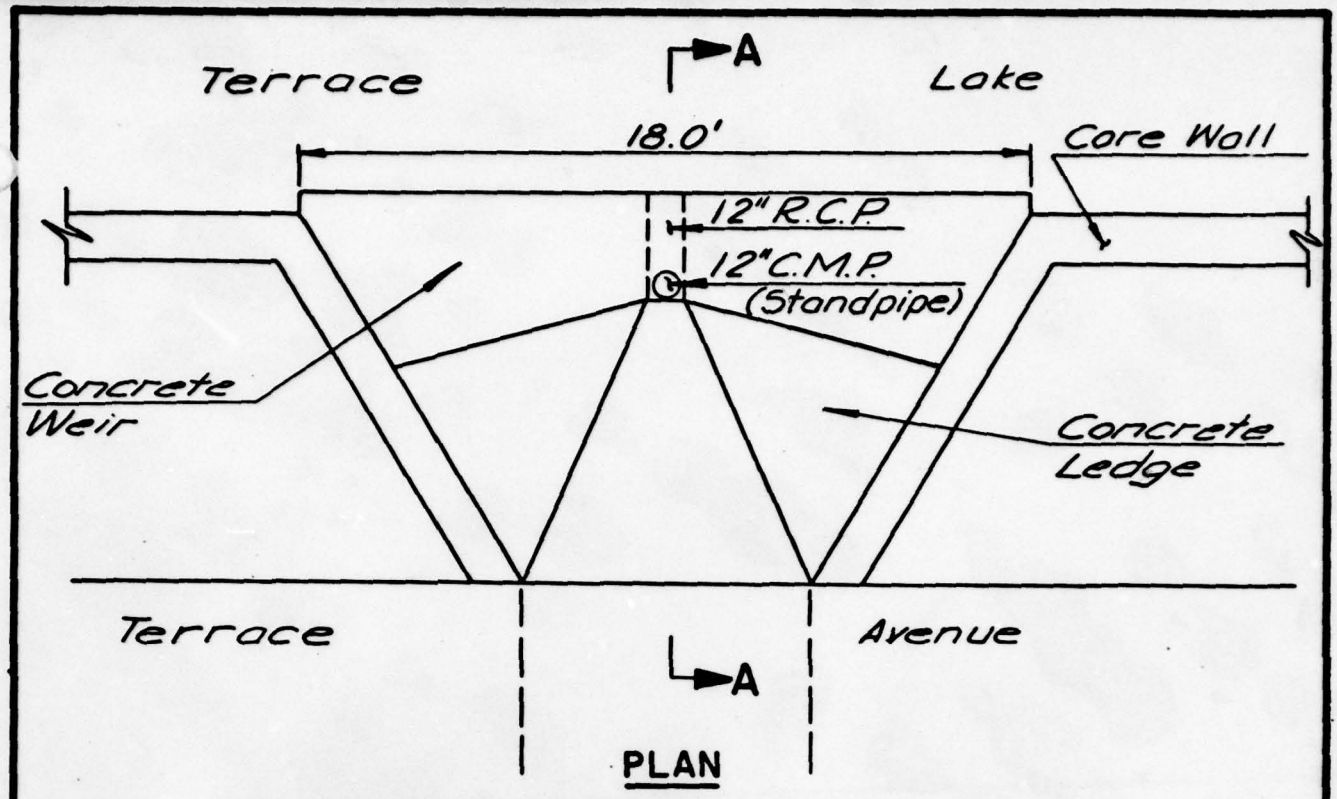
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

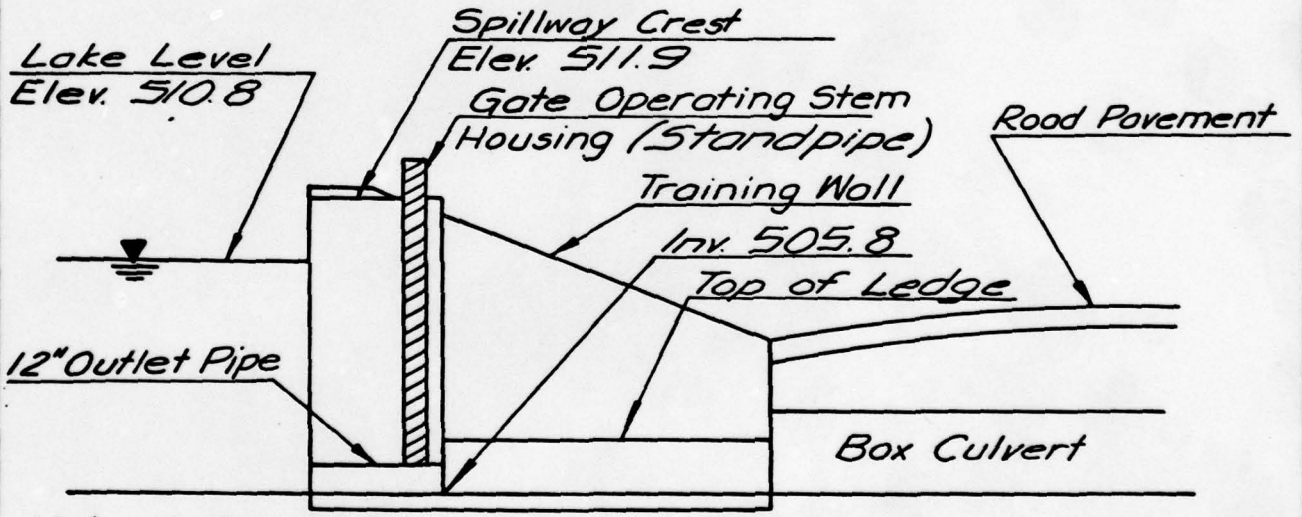
GENERAL PLAN

TERRACE LAKE DAM

NJ00542	SCALE: NOT TO SCALE
	DATE: JULY 1979



PLAN

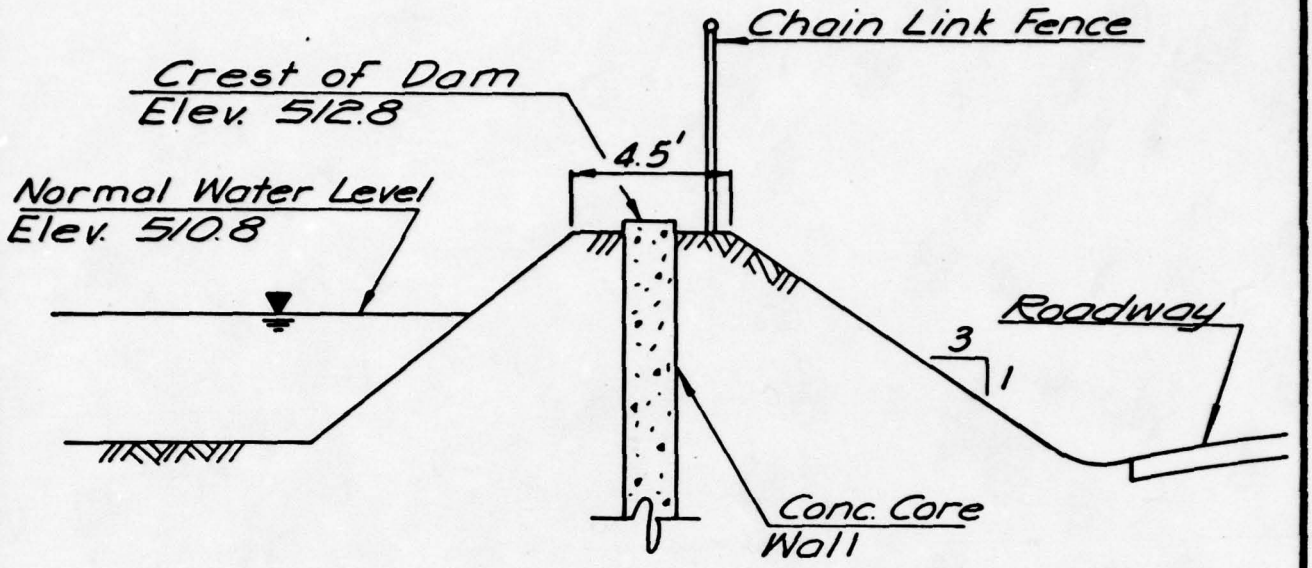


Note: Information taken from field inspection May 2, 1979.

SECTION A-A

PLATE 6

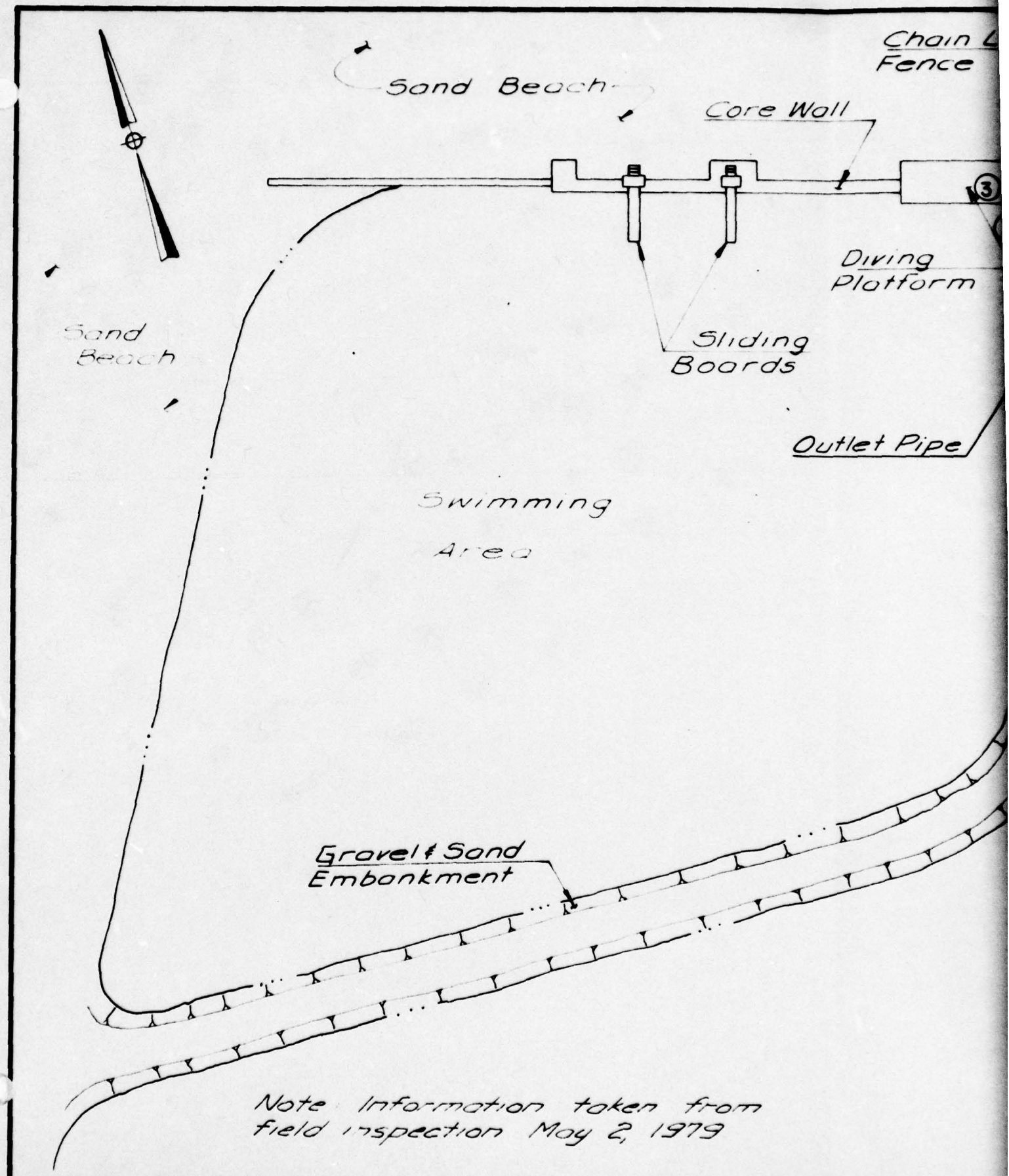
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS SPILLWAY PLAN & SECTION TERRACE LAKE DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. NJ00542 — SCALE: NOT TO SCALE DATE: JULY, 1979



Note: Information taken from field inspection May 8, 1979.

PLATE 7

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS DAM SECTION TERRACE LAKE DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. NJ00542 — SCALE: NOT TO SCALE DATE: JULY, 1979


Chain L
Fence
Sand Beach
Core Wall
3
Diving
Platform
Sand
Beach
Sliding
Boards
Outlet Pipe
Swimming
Area
Gravel & Sand
Embankment
Note Information taken from
field inspection May 2, 1979

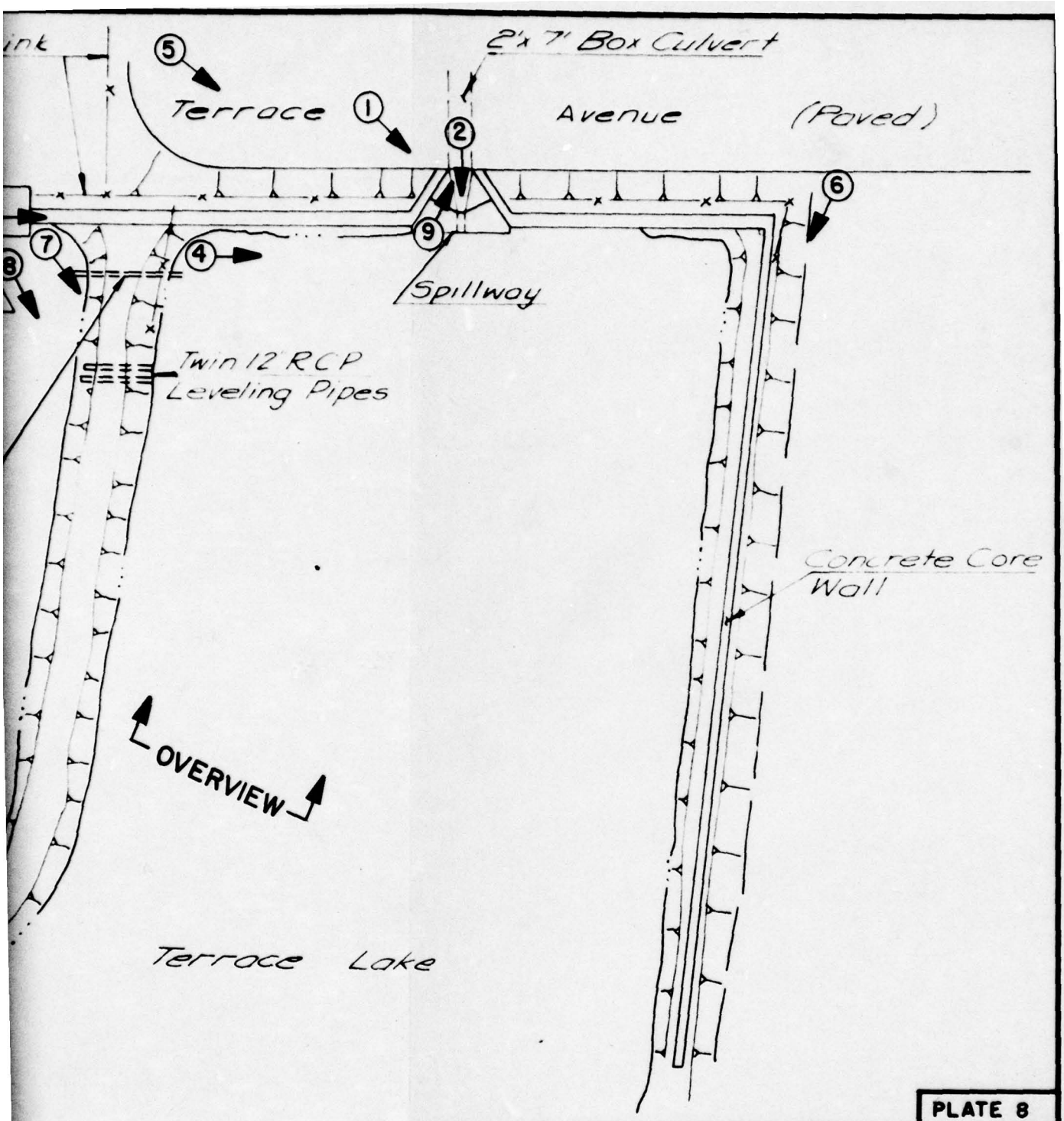


PLATE 8

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

PHOTO LOCATION PLAN

TERRACE LAKE DAM

I.D. N[illegible]542	SCALE: NOT TO SCALE
	DATE: JULY, 1979

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List
Visual Inspection
Phase I

Name of Dam Terrace Lake County Morris State New Jersey Coordinators NJDEP

Date(s) Inspection 5/2/79 Weather Fair Temperature 65°F

Pool Elevation at Time of Inspection 510.8 M.S.L. Tailwater at Time of Inspection N.A. M.S.L.
(No discharge over spillway.)

Inspection Personnel:

John Gribbin David Hoyt Andrew Miller

Ronald Lai Joseph Fox

Richard McDermott

John Gribbin Recorder

Present: William Dunlop, Christian Recreational Association

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	N.A.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N.A.	
DRAINS	N.A.	
WATER PASSAGES	N.A.	
FOUNDATION	N.A.	
VERTICAL AND HORIZONTAL ALIGNMENT	N.A.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N.A.	
STRUCTURAL CRACKING	N.A.	
CONSTRUCTION JOINTS	N.A.	
MONOLITH JOINTS	N.A.	
LEAKAGE	N.A.	
SEEPAGE	N.A.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Embankment generally grass covered with some bare areas. Trees are located on embankment along east edge of lake. A chain-link fence is located along the north section of embankment; condition is generally satisfactory.	Embankment is located along north and east edges of lake.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be in satisfactory condition.	
ANY NOTICEABLE SEEPAGE	None	
STAFF GAGE AND RECORDER	None	
CORE WALL	Along the north edge of lake, the core wall appears structurally stable but with some deterioration of the surface. Some patching noted. Along the east edge of lake, the core wall is extensively deteriorated with displacement noted.	An exposed concrete core wall is locat along the center of the dam for its entire length.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Some erosion noted along most of the length of embankment.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical: varies, but generally level. Horizontal: straight with 90-degree bend.	
RIPRAP FAILURES	Unknown.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES IN OUTLET CONDUIT	N.A.	
INTAKE STRUCTURE	Submerged.	
OUTLET STRUCTURE	Discharge end of pipe could be observed. Appeared to be in satisfactory condition.	
OUTLET CHANNEL	Same as spillway discharge channel.	
GATE AND GATE HOUSING	Gate could not be clearly observed. Gate operating mechanism appeared to be in satisfactory condition but was not operated at time of inspection.	

SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
CONCRETE WEIR	Appeared to be in good condition.	
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	Formed by downstream sections of training walls and by downstream apron. Appears to be in generally satisfactory condition.	
GENERAL	Spillway training walls and downstream apron appeared to be in generally satisfactory condition.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATION
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	N.A.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
SLOPES	Generally moderate with grades of 2% to 5%.	
SEDIMENTATION	Unknown	
STRUCTURES ALONG BANKS	Approx. 3 houses located along east shore of lake. Swimming dock and slides located along swimming section of lake.	Swimming area of lake separated by gra dike. Reinforced concrete leveling pi observed in dike. Also operating mech nism for outlet pipe used to drain swimming section observed.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Rocks and debris at entrance to box culvert result in a significant obstruction to flow.	Discharge from spillway discharge cha enters box culvert under minor road directly downstream from dam.
SLOPES	From the box culvert, discharge is piped across a lawn to a small pond. The pond outlets into a small stream bed located between backyards of homes.	
STRUCTURES ALONG BANKS	3 homes are located adjacent to the small pond approx. 100' downstream from the dam.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
DAM - PLAN	Not Available
SECTIONS	Not Available
SPILLWAY - PLAN	Not Available
SECTIONS	Not Available
DETAILS	Not Available
OPERATING EQUIPMENT PLANS & DETAILS	Not Available
OUTLETS - PLAN	Not Available
DETAILS	Not Available
CONSTRAINTS	Not Available
DISCHARGE RATINGS	Not Available
HYDRAULIC/HYDROLOGIC DATA	Not Available
RAINFALL/RESERVOIR RECORDS	Not Available
CONSTRUCTION HISTORY	Not Available
LOCATION MAP	Not Available

ITEM	REMARKS
DESIGN REPORTS	Not Available
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not Available
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	Not Available
HIGH POOL RECORDS	Not Available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not Available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Not Available
MAINTENANCE OPERATION RECORDS	Not Available

APPENDIX 2

Photographs

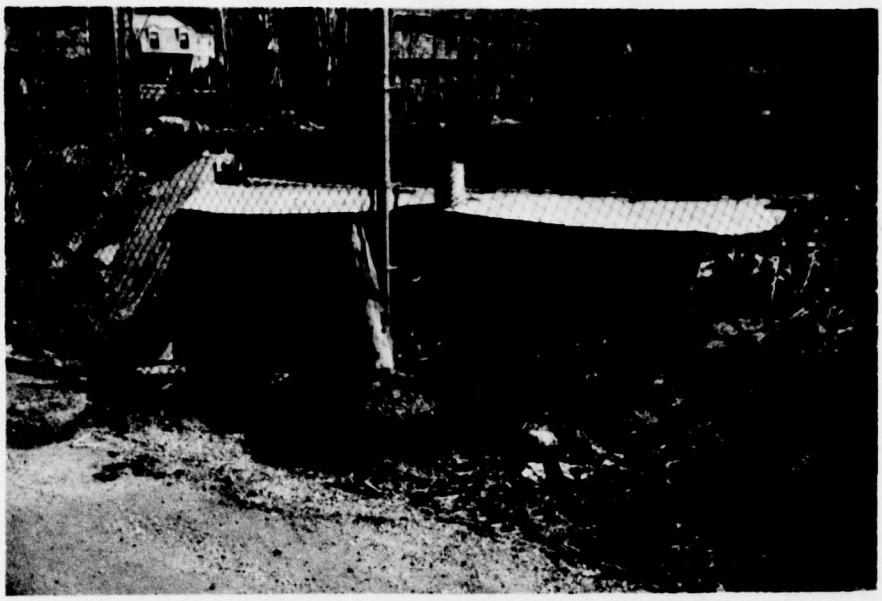


PHOTO 1

SPILLWAY CREST

PHOTO 2

DOWNSTREAM VIEW OF OUTLET WORKS

TERRACE LAKE DAM
2 MAY 1979

PHOTO 3

CREST OF DAM - NORTH EDGE OF LAKE

PHOTO 4

UPSTREAM FACE OF DAM - NORTH EDGE OF LAKE

TERRACE LAKE DAM

2 MAY 1979

PHOTO 5

DOWNSTREAM FACE OF DAM - NORTH EDGE OF LAKE

PHOTO 6

DOWNSTREAM FACE OF DAM - EAST EDGE OF LAKE

TERRACE LAKE DAM

2 MAY 1979

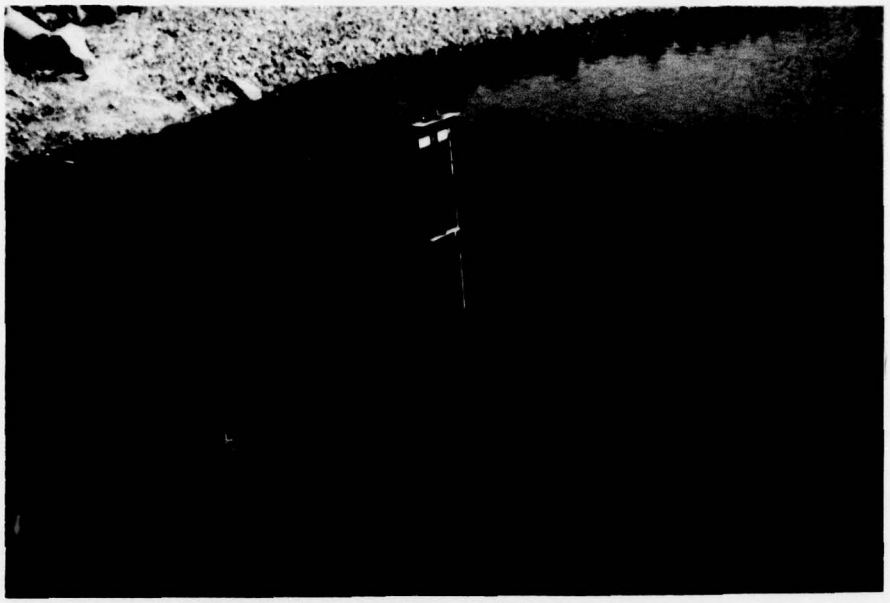


PHOTO 7

OPERATING MECHANISM FOR OUTLET
FROM SWIMMING AREA TO MAIN LAKE

PHOTO 8

LEVELING PIPES IN DIKE BETWEEN
SWIMMING AREA AND MAIN LAKE

TERRACE LAKE DAM
2 MAY 1979

PHOTO 9

CULVERT UNDER ROAD DOWNSTREAM FROM SPILLWAY

PHOTO 10

OUTLET OF CULVERT DOWNSTREAM FROM SPILLWAY

TERRACE LAKE DAM
2 MAY 1979

APPENDIX 3

Engineering Data

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 50% developed, 50% wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 510.8 (11 Acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N.A.

ELEVATION MAXIMUM DESIGN POOL: 513.3

ELEVATION TOP DAM: 512.8

SPILLWAY CREST: Concrete Weir

a. Elevation 511.9
b. Type Uncontrolled
c. Width Varies 2 to 4 feet
d. Length 18 feet
e. Location Spillover At center of north-south section of dam
f. Number and Type of Gates N.A.

OUTLET WORKS: 12 inch pipe

a. Type Gated pipe
b. Location At center of spillway
c. Entrance inverts 505.8
d. Exit inverts 505.8
e. Emergency draindown facilities: Open Gate

HYDROMETEOROLOGICAL GAGES: None

a. Type N.A.
b. Location N.A.
c. Records N.A.

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake stage equal to top of dam) 42 c.f.s.

APPENDIX 4

Hydrologic Computations

HYDROLOGY

Hydrologic Analysis

Runoff hydrograph will be developed by HEC-1-DB using the SCS triangular hydrograph with the curvilinear transformation.

Drainage Area = 0.5 sq. mile

Infiltration Data

Mostly Developed

use initial infiltration 1.0 in

constant infiltration 0.1 in/hr.

Time of Concentration. SCS TR-55

Overland flow 3000 ft

channel or pipe flow 1200 ft

Average slope 0.16 %

$$Tc = \left(\frac{3000}{1.0} + \frac{1200}{1.8}\right)\frac{1}{3600}$$

$$= 1 \text{ hr.}$$

Time of Concentration by Kerby

Pg 14-36

"Handbook of Applied Hydrology" by Chow

$$t_c^{2.14} = \frac{2}{3} \frac{Ln}{\sqrt{S}}$$

t_c = time of concentration in min

L = length of overland flow in ft

S = slope

n = 0.4 roughness coef.

$$t_c^{2.14} = \frac{2}{3} \frac{3000 \times 0.4}{\sqrt{0.016}}$$

t_c overland = 1 hr.

$$T_C = 1 \text{ hr} + 0.185 \text{ hr}$$

$$= 1.2 \text{ hr.}$$

For HEC-2 input use Lag = 0.6 hr

Hydraulics

Spillway capacity can be calculated by

$Q = CLh^{1.5}$ where $C = 2.7$

Ref. "Handbook of Hydraulics, King"

$L = 18$ feet

Stage Discharge Tabulation

W.L. (ft)	h (ft)	Q (cfs)
511.9	0	0
512.9	1	49
513.9	2	137
514.9	3	253
515.9	4	389

STORCH ENGINEERS

Sheet 4 of 6

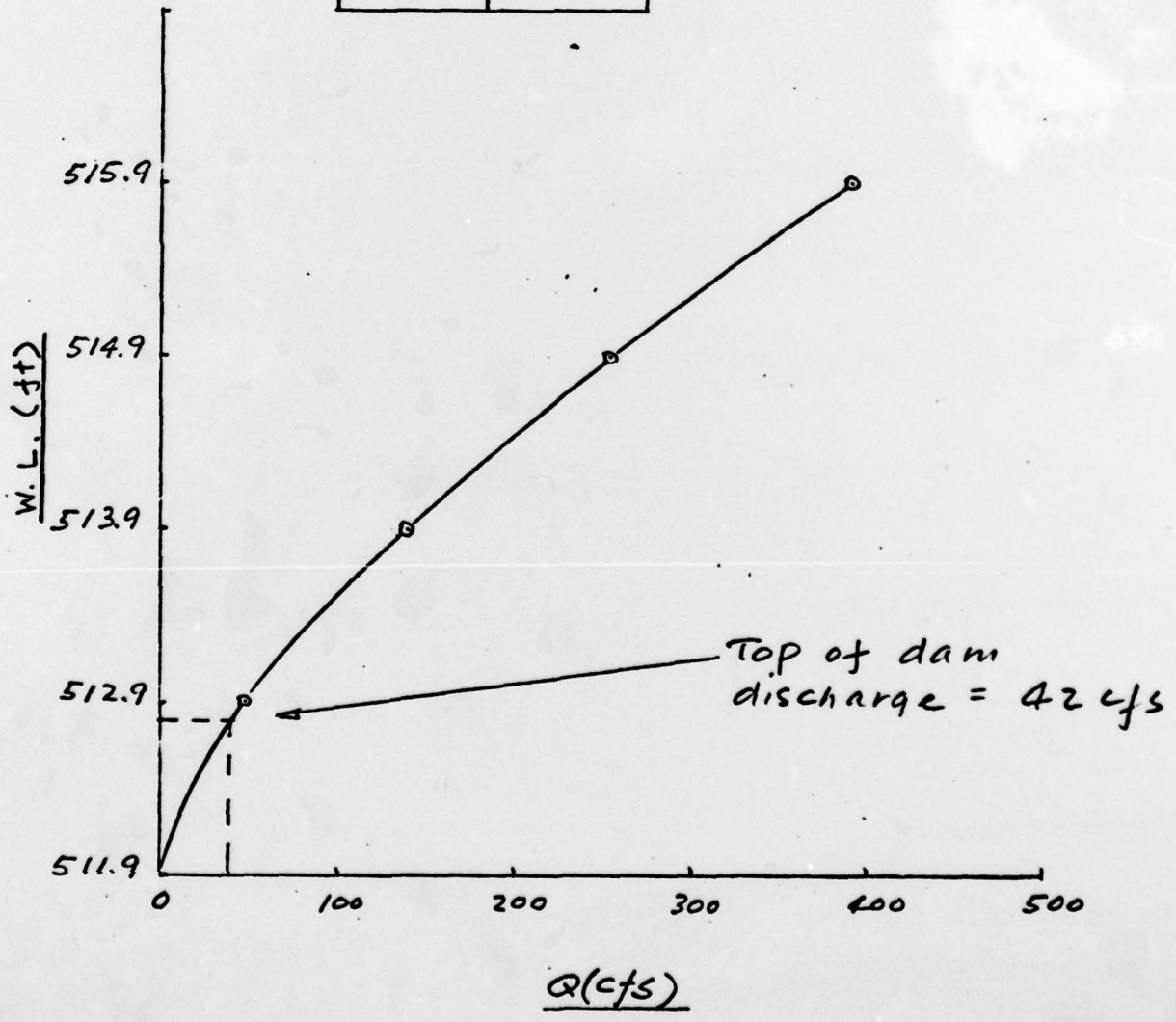
Project Terrace Lake 1132 B

Made By RL Date 7-16-79

Chkd By JG Date 7-20-79

Spillway
STAGE DISCHARGE CURVE

W.L. (ft)	Q (cfs)
511.9	0
512.9	49
513.9	137
514.9	253
515.9	389



Lake Storage Volume

Information from USGS & Aerial Photos

Elev (M.S.L)	Surface Area (AC)
511	7
515	13
520	21

Dam crest elev. 512.8

Length of dam 737 feet

Outlet works Capacity

12" RCP outlet pipe

Both inlet and outlet submerged

outlet control

$H = 510.8 - TW$

TW use 507.8

$H = 510.8 - 507.8$

$= 3$

From "Hydraulic Charts for the Selection of Highway Culverts"

$Q = \underline{\underline{8}}$ cfs

Estimated drawdown time

$$T = \frac{19 \times 43560}{4 \times 3600} = \underline{\underline{57.5 \text{ hours}}}$$

HEC-1-DB COMPUTATIONS

```
A1                    NATIONAL DAM SAFETY PROGRAM
A2                 TERRACE LAKE  NEW JERSEY
A3                  100 YR STORM ROUTING
B     150         0       20                                        0       0       3
B1      5
J       1         1        1
J1      1
K       0      LAKE                          0       0       1
K1                INFLOW HYDROGRAPH TO TERRACE LAKE DAM
M       0         2      0.5                 0.5                                    1
O      72         0
O1  0.027     0.027    0.027    0.027    0.027    0.027    0.027    0.027    0.027    0.027
O1  0.027     0.027    0.027    0.027    0.027    0.027    0.027    0.027    0.027    0.027
O1   0.03      0.03     0.03     0.03     0.06     0.06     0.06     0.06     0.06     0.06
O1   0.06      0.06     0.06    0.063    0.063    0.063      0.1      0.1      0.1      0.1
O1    0.1       0.1     0.27     0.27     0.27      1.0      1.0      1.0     0.13     0.13
O1   0.13       0.1      0.1      0.1    0.063    0.063    0.063     0.06     0.06     0.06
O1   0.03      0.03     0.03     0.03     0.03     0.03    0.027    0.027    0.027    0.027
O1  0.027     0.027
T                                                          1.0      0.1
W2                0.6
X    -1.0     -0.05      2.0
K       1       DAM                       0       0       1
K1                          ROUTE DISCHARGE THRU DAM
V                                     1       1
Y1      1                                                -510.8       -1
Y4  511.9     512.9    513.9    514.9    515.9
Y5      0        49      137      253      389
SA      0         7       13       21
SE  505.8       511      515      520
SS  511.9
SD  512.8      2.63      1.5      719
K      99
A
A
A
A
A
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
 LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 79/07/18.
     TIME= 10.58.07.
```

NATIONAL DAM SAFETY PROGRAM
TERRACE LAKE NEW JERSEY
100 YR STORM ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	20	0	0	0	0	0	3	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

RTIOS= 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO TERRACE LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	.50	0.00	.50	0.00	0.000	0	1	0

PRECIP DATA

NP	STORM	DAJ	DAK
72	0.00	0.00	0.00

PRECIP PATTERN

.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.06	.06	.06	.06	.06	.06
.06	.06	.06	.06	.06	.06	.10	.10	.10	.10
.10	.10	.27	.27	.27	1.00	1.00	1.00	.13	.13
.13	.10	.10	.10	.06	.06	.06	.06	.06	.06
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03								

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .60

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 11 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .60 VOL= 1.00

316. 308. 272. 137. 69. 34. 16. 8. 4. 2.
1.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.20	1	.03	0.00	.03	0.
1.01	.40	2	.03	0.00	.03	0.
1.01	1.00	3	.03	0.00	.03	0.
1.01	1.20	4	.03	0.00	.03	0.
1.01	1.40	5	.03	0.00	.03	0.
1.01	2.00	6	.03	0.00	.03	0.
1.01	2.20	7	.03	0.00	.03	0.
1.01	2.40	8	.03	0.00	.03	0.
1.01	3.00	9	.03	0.00	.03	0.
1.01	3.20	10	.03	0.00	.03	0.
1.01	3.40	11	.03	0.00	.03	0.
1.01	4.00	12	.03	0.00	.03	0.
1.01	4.20	13	.03	0.00	.03	0.
1.01	4.40	14	.03	0.00	.03	0.
1.01	5.00	15	.03	0.00	.03	0.
1.01	5.20	16	.03	0.00	.03	0.
1.01	5.40	17	.03	0.00	.03	0.
1.01	6.00	18	.03	0.00	.03	0.
1.01	6.20	19	.03	0.00	.03	0.
1.01	6.40	20	.03	0.00	.03	0.
1.01	7.00	21	.03	0.00	.03	0.
1.01	7.20	22	.03	0.00	.03	0.
1.01	7.40	23	.03	0.00	.03	0.
1.01	8.00	24	.03	0.00	.03	0.
1.01	8.20	25	.06	0.00	.06	0.
1.01	8.40	26	.06	0.00	.06	0.
1.01	9.00	27	.06	0.00	.06	0.
1.01	9.20	28	.06	0.00	.06	0.
1.01	9.40	29	.06	0.00	.06	0.
1.01	10.00	30	.06	.01	.05	1.
1.01	10.20	31	.06	.03	.03	7.
1.01	10.40	32	.06	.03	.03	15.
1.01	11.00	33	.06	.03	.03	20.
1.01	11.20	34	.06	.03	.03	23.
1.01	11.40	35	.06	.03	.03	26.
1.01	12.00	36	.06	.03	.03	27.
1.01	12.20	37	.10	.07	.03	32.
1.01	12.40	38	.10	.07	.03	44.
1.01	13.00	39	.10	.07	.03	54.
1.01	13.20	40	.10	.07	.03	60.
1.01	13.40	41	.10	.07	.03	62.
1.01	14.00	42	.10	.07	.03	63.
1.01	14.20	43	.27	.24	.03	84.
1.01	14.40	44	.27	.24	.03	136.
1.01	15.00	45	.27	.24	.03	183.
1.01	15.20	46	1.00	.97	.03	291.
1.01	15.40	47	1.00	.97	.03	528.
1.01	16.00	48	1.00	.97	.03	732.
1.01	16.20	49	.13	.10	.03	734.
1.01	16.40	50	.13	.10	.03	517.
1.01	17.00	51	.13	.10	.03	306.
1.01	17.20	52	.10	.07	.03	195.
1.01	17.40	53	.10	.07	.03	132.
1.01	18.00	54	.10	.07	.03	98.
1.01	18.20	55	.06	.03	.03	77.
1.01	18.40	56	.06	.03	.03	57.
1.01	19.00	57	.06	.03	.03	42.
1.01	19.20	58	.06	.03	.03	36.
1.01	19.40	59	.06	.03	.03	34.
1.01	20.00	60	.06	.03	.03	31.
1.01	20.20	61	.03	0.00	.03	29.
1.01	20.40	62	.03	0.00	.03	27.
1.01	21.00	63	.03	0.00	.03	25.
1.01	21.20	64	.03	0.00	.03	24.
1.01	21.40	65	.03	0.00	.03	22.
1.01	22.00	66	.03	0.00	.03	21.
1.01	22.20	67	.03	0.00	.03	19.
1.01	22.40	68	.03	0.00	.03	18.
1.01	23.00	69	.03	0.00	.03	17.
1.01	23.20	70	.03	0.00	.03	16.
1.01	23.40	71	.03	0.00	.03	15.
1.02	0.00	72	.03	0.00	.03	14.
1.02	.20	73	0.00	0.00	0.00	13.
1.02	.40	74	0.00	0.00	0.00	12.
1.02	1.00	75	0.00	0.00	0.00	11.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.02	1.20	76	0.00	0.00	0.00	10.
1.02	1.40	77	0.00	0.00	0.00	10.
1.02	2.00	78	0.00	0.00	0.00	9.
1.02	2.20	79	0.00	0.00	0.00	8.
1.02	2.40	80	0.00	0.00	0.00	8.
1.02	3.00	81	0.00	0.00	0.00	7.
1.02	3.20	82	0.00	0.00	0.00	7.
1.02	3.40	83	0.00	0.00	0.00	6.
1.02	4.00	84	0.00	0.00	0.00	6.
1.02	4.20	85	0.00	0.00	0.00	6.
1.02	4.40	86	0.00	0.00	0.00	5.
1.02	5.00	87	0.00	0.00	0.00	5.
1.02	5.20	88	0.00	0.00	0.00	4.
1.02	5.40	89	0.00	0.00	0.00	4.
1.02	6.00	90	0.00	0.00	0.00	4.
1.02	6.20	91	0.00	0.00	0.00	4.
1.02	6.40	92	0.00	0.00	0.00	3.
1.02	7.00	93	0.00	0.00	0.00	3.
1.02	7.20	94	0.00	0.00	0.00	3.
1.02	7.40	95	0.00	0.00	0.00	3.
1.02	8.00	96	0.00	0.00	0.00	3.
1.02	8.20	97	0.00	0.00	0.00	2.
1.02	8.40	98	0.00	0.00	0.00	2.
1.02	9.00	99	0.00	0.00	0.00	2.
1.02	9.20	100	0.00	0.00	0.00	2.
1.02	9.40	101	0.00	0.00	0.00	2.
1.02	10.00	102	0.00	0.00	0.00	2.
1.02	10.20	103	0.00	0.00	0.00	2.
1.02	10.40	104	0.00	0.00	0.00	1.
1.02	11.00	105	0.00	0.00	0.00	1.
1.02	11.20	106	0.00	0.00	0.00	1.
1.02	11.40	107	0.00	0.00	0.00	1.
1.02	12.00	108	0.00	0.00	0.00	1.
1.02	12.20	109	0.00	0.00	0.00	1.
1.02	12.40	110	0.00	0.00	0.00	1.
1.02	13.00	111	0.00	0.00	0.00	1.
1.02	13.20	112	0.00	0.00	0.00	1.
1.02	13.40	113	0.00	0.00	0.00	1.
1.02	14.00	114	0.00	0.00	0.00	1.
1.02	14.20	115	0.00	0.00	0.00	1.
1.02	14.40	116	0.00	0.00	0.00	1.
1.02	15.00	117	0.00	0.00	0.00	1.
1.02	15.20	118	0.00	0.00	0.00	1.
1.02	15.40	119	0.00	0.00	0.00	1.
1.02	16.00	120	0.00	0.00	0.00	0.
1.02	16.20	121	0.00	0.00	0.00	0.
1.02	16.40	122	0.00	0.00	0.00	0.
1.02	17.00	123	0.00	0.00	0.00	0.
1.02	17.20	124	0.00	0.00	0.00	0.
1.02	17.40	125	0.00	0.00	0.00	0.
1.02	18.00	126	0.00	0.00	0.00	0.
1.02	18.20	127	0.00	0.00	0.00	0.
1.02	18.40	128	0.00	0.00	0.00	0.
1.02	19.00	129	0.00	0.00	0.00	0.
1.02	19.20	130	0.00	0.00	0.00	0.
1.02	19.40	131	0.00	0.00	0.00	0.
1.02	20.00	132	0.00	0.00	0.00	0.
1.02	20.20	133	0.00	0.00	0.00	0.
1.02	20.40	134	0.00	0.00	0.00	0.
1.02	21.00	135	0.00	0.00	0.00	0.
1.02	21.20	136	0.00	0.00	0.00	0.
1.02	21.40	137	0.00	0.00	0.00	0.
1.02	22.00	138	0.00	0.00	0.00	0.
1.02	22.20	139	0.00	0.00	0.00	0.
1.02	22.40	140	0.00	0.00	0.00	0.
1.02	23.00	141	0.00	0.00	0.00	0.
1.02	23.20	142	0.00	0.00	0.00	0.
1.02	23.40	143	0.00	0.00	0.00	0.
1.03	0.00	144	0.00	0.00	0.00	0.
1.03	.20	145	0.00	0.00	0.00	0.
1.03	.40	146	0.00	0.00	0.00	0.
1.03	1.00	147	0.00	0.00	0.00	0.
1.03	1.20	148	0.00	0.00	0.00	0.
1.03	1.40	149	0.00	0.00	0.00	0.
1.03	2.00	150	0.00	0.00	0.00	0.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
512.8	2.6	1.5	719.

STATION DAM, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.20	1	.33	0.	0.	11.	510.8
1.01	.40	2	.67	0.	0.	11.	510.8
1.01	1.00	3	1.00	0.	0.	11.	510.8
1.01	1.20	4	1.33	0.	0.	11.	510.8
1.01	1.40	5	1.67	0.	0.	11.	510.8
1.01	2.00	6	2.00	0.	0.	11.	510.8
1.01	2.20	7	2.33	0.	0.	11.	510.8
1.01	2.40	8	2.67	0.	0.	11.	510.8
1.01	3.00	9	3.00	0.	0.	11.	510.8
1.01	3.20	10	3.33	0.	0.	11.	510.8
1.01	3.40	11	3.67	0.	0.	11.	510.8
1.01	4.00	12	4.00	0.	0.	11.	510.8
1.01	4.20	13	4.33	0.	0.	11.	510.8
1.01	4.40	14	4.67	0.	0.	11.	510.8
1.01	5.00	15	5.00	0.	0.	11.	510.8
1.01	5.20	16	5.33	0.	0.	11.	510.8
1.01	5.40	17	5.67	0.	0.	11.	510.8
1.01	6.00	18	6.00	0.	0.	11.	510.8
1.01	6.20	19	6.33	0.	0.	11.	510.8
1.01	6.40	20	6.67	0.	0.	11.	510.8
1.01	7.00	21	7.00	0.	0.	11.	510.8
1.01	7.20	22	7.33	0.	0.	11.	510.8
1.01	7.40	23	7.67	0.	0.	11.	510.8
1.01	8.00	24	8.00	0.	0.	11.	510.8
1.01	8.20	25	8.33	0.	0.	11.	510.8
1.01	8.40	26	8.67	0.	0.	11.	510.8
1.01	9.00	27	9.00	0.	0.	11.	510.8
1.01	9.20	28	9.33	0.	0.	11.	510.8
1.01	9.40	29	9.67	0.	0.	11.	510.8
1.01	10.00	30	10.00	1.	0.	11.	510.8
1.01	10.20	31	10.33	7.	0.	11.	510.8
1.01	10.40	32	10.67	15.	0.	11.	510.9
1.01	11.00	33	11.00	20.	0.	12.	511.0
1.01	11.20	34	11.33	23.	0.	12.	511.0
1.01	11.40	35	11.67	26.	0.	13.	511.1
1.01	12.00	36	12.00	27.	0.	14.	511.2
1.01	12.20	37	12.33	32.	0.	15.	511.4
1.01	12.40	38	12.67	44.	0.	16.	511.5
1.01	13.00	39	13.00	54.	0.	17.	511.7
1.01	13.20	40	13.33	60.	0.	19.	511.9
1.01	13.40	41	13.67	62.	8.	20.	512.1
1.01	14.00	42	14.00	63.	16.	22.	512.2
1.01	14.20	43	14.33	84.	24.	23.	512.4
1.01	14.40	44	14.67	136.	36.	25.	512.6
1.01	15.00	45	15.00	183.	104.	28.	512.9
1.01	15.20	46	15.33	291.	273.	29.	513.0
1.01	15.40	47	15.67	528.	462.	30.	513.1
1.01	16.00	48	16.00	732.	705.	32.	513.3
1.01	16.20	49	16.33	734.	744.	32.	513.3
1.01	16.40	50	16.67	517.	571.	31.	513.2
1.01	17.00	51	17.00	306.	346.	30.	513.1
1.01	17.20	52	17.33	195.	218.	29.	513.0
1.01	17.40	53	17.67	132.	149.	28.	512.9
1.01	18.00	54	18.00	98.	108.	28.	512.9
1.01	18.20	55	18.33	77.	85.	28.	512.9
1.01	18.40	56	18.67	57.	66.	27.	512.8
1.01	19.00	57	19.00	42.	51.	27.	512.8
1.01	19.20	58	19.33	36.	44.	27.	512.8
1.01	19.40	59	19.67	34.	43.	27.	512.8
1.01	20.00	60	20.00	31.	42.	26.	512.8
1.01	20.20	61	20.33	29.	40.	26.	512.7
1.01	20.40	62	20.67	27.	39.	26.	512.7
1.01	21.00	63	21.00	25.	37.	26.	512.7
1.01	21.20	64	21.33	24.	35.	25.	512.6
1.01	21.40	65	21.67	22.	34.	25.	512.6
1.01	22.00	66	22.00	21.	32.	25.	512.6
1.01	22.20	67	22.33	19.	30.	24.	512.5
1.01	22.40	68	22.67	18.	29.	24.	512.5
1.01	23.00	69	23.00	17.	27.	24.	512.5
1.01	23.20	70	23.33	16.	26.	23.	512.4
1.01	23.40	71	23.67	15.	24.	23.	512.4
1.02	0.00	72	24.00	14.	23.	23.	512.4
1.02	.20	73	24.33	13.	21.	23.	512.3
1.02	.40	74	24.67	12.	20.	22.	512.3

PEAK OUTFLOW IS 744. AT TIME 16.33 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.02	1.00	75	25.00	11.	19.	22.	512.3
1.02	1.20	76	25.33	10.	18.	22.	512.3
1.02	1.40	77	25.67	10.	17.	22.	512.2
1.02	2.00	78	26.00	9.	15.	22.	512.2
1.02	2.20	79	26.33	8.	15.	21.	512.2
1.02	2.40	80	26.67	8.	14.	21.	512.2
1.02	3.00	81	27.00	7.	13.	21.	512.2
1.02	3.20	82	27.33	7.	12.	21.	512.2
1.02	3.40	83	27.67	6.	12.	21.	512.1
1.02	4.00	84	28.00	6.	11.	21.	512.1
1.02	4.20	85	28.33	6.	10.	21.	512.1
1.02	4.40	86	28.67	5.	10.	21.	512.1
1.02	5.00	87	29.00	5.	9.	20.	512.1
1.02	5.20	88	29.33	4.	8.	20.	512.1
1.02	5.40	89	29.67	4.	8.	20.	512.1
1.02	6.00	90	30.00	4.	7.	20.	512.1
1.02	6.20	91	30.33	4.	7.	20.	512.0
1.02	6.40	92	30.67	3.	6.	20.	512.0
1.02	7.00	93	31.00	3.	6.	20.	512.0
1.02	7.20	94	31.33	3.	6.	20.	512.0
1.02	7.40	95	31.67	3.	5.	20.	512.0
1.02	8.00	96	32.00	3.	5.	20.	512.0
1.02	8.20	97	32.33	2.	5.	20.	512.0
1.02	8.40	98	32.67	2.	4.	20.	512.0
1.02	9.00	99	33.00	2.	4.	20.	512.0
1.02	9.20	100	33.33	2.	4.	20.	512.0
1.02	9.40	101	33.67	2.	3.	20.	512.0
1.02	10.00	102	34.00	2.	3.	19.	512.0
1.02	10.20	103	34.33	2.	3.	19.	512.0
1.02	10.40	104	34.67	1.	3.	19.	512.0
1.02	11.00	105	35.00	1.	3.	19.	512.0
1.02	11.20	106	35.33	1.	2.	19.	511.9
1.02	11.40	107	35.67	1.	2.	19.	511.9
1.02	12.00	108	36.00	1.	2.	19.	511.9
1.02	12.20	109	36.33	1.	2.	19.	511.9
1.02	12.40	110	36.67	1.	2.	19.	511.9
1.02	13.00	111	37.00	1.	2.	19.	511.9
1.02	13.20	112	37.33	1.	2.	19.	511.9
1.02	13.40	113	37.67	1.	1.	19.	511.9
1.02	14.00	114	38.00	1.	1.	19.	511.9
1.02	14.20	115	38.33	1.	1.	19.	511.9
1.02	14.40	116	38.67	1.	1.	19.	511.9
1.02	15.00	117	39.00	1.	1.	19.	511.9
1.02	15.20	118	39.33	1.	1.	19.	511.9
1.02	15.40	119	39.67	1.	1.	19.	511.9
1.02	16.00	120	40.00	0.	1.	19.	511.9
1.02	16.20	121	40.33	0.	1.	19.	511.9
1.02	16.40	122	40.67	0.	1.	19.	511.9
1.02	17.00	123	41.00	0.	1.	19.	511.9
1.02	17.20	124	41.33	0.	1.	19.	511.9
1.02	17.40	125	41.67	0.	1.	19.	511.9
1.02	18.00	126	42.00	0.	1.	19.	511.9
1.02	18.20	127	42.33	0.	1.	19.	511.9
1.02	18.40	128	42.67	0.	1.	19.	511.9
1.02	19.00	129	43.00	0.	0.	19.	511.9
1.02	19.20	130	43.33	0.	0.	19.	511.9
1.02	19.40	131	43.67	0.	0.	19.	511.9
1.02	20.00	132	44.00	0.	0.	19.	511.9
1.02	20.20	133	44.33	0.	0.	19.	511.9
1.02	20.40	134	44.67	0.	0.	19.	511.9
1.02	21.00	135	45.00	0.	0.	19.	511.9
1.02	21.20	136	45.33	0.	0.	19.	511.9
1.02	21.40	137	45.67	0.	0.	19.	511.9
1.02	22.00	138	46.00	0.	0.	19.	511.9
1.02	22.20	139	46.33	0.	0.	19.	511.9
1.02	22.40	140	46.67	0.	0.	19.	511.9
1.02	23.00	141	47.00	0.	0.	19.	511.9
1.02	23.20	142	47.33	0.	0.	19.	511.9
1.02	23.40	143	47.67	0.	0.	19.	511.9
1.03	0.00	144	48.00	0.	0.	19.	511.9
1.03	.20	145	48.33	0.	0.	19.	511.9
1.03	.40	146	48.67	0.	0.	19.	511.9
1.03	1.00	147	49.00	0.	0.	19.	511.9
1.03	1.20	148	49.33	0.	0.	19.	511.9
1.03	1.40	149	49.67	0.	0.	19.	511.9
1.03	2.00	150	50.00	0.	0.	19.	511.9

SUMMARY OF DAM SAFETY ANALYSIS

••••••••••••••••		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	510.80	511.90	512.80
	STORAGE	11.	19.	27.
	OUTFLOW	0.	0.	44.

100 yr. Storm

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	513.30	.50	32.	744.	4.33	16.33	0.00

APPENDIX 5

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